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*Flood and Erosion Control as Possible Unemployment Relief Measures:* DR. L. E. FREUDENTHAL ..... 445

*Research with a Hen:* PROFESSOR F. B. HUTT ..... 449

*Scientific Events:*
*The Algernon Firth Pathological Institute at the University of Leeds; Junior Science Clubs of the American Institute; The Third Technical and Chemical International Congress of Agricultural Industries; The Cincinnati and Boston Meetings of the American Physical Society; The New Chief of the Bureau of Plant Industry; Recent Deaths* ... 452

*Scientific Notes and News* ..... 455

*Discussion:*
*Paleospondylus; A Nematode Parasite in Myxinoids:* THE LATE DR. HOWARD AYERS. *The Thickness of the Glacial Deposits in Ohio:* PROFESSOR KARL VER STEEG. *Biological Isomerism of Water Made of Protium and Deuterium:* DR. ISAY BALINKIN. *The Spiral Habit:* DR. CHARLES SKEELE PALMER ..... 458

*Special Correspondence:*
*Academic Freedom in Germany* ..... 460

*Scientific Apparatus and Laboratory Methods:*
*A Sorting Stage for Foraminifera:* DR. BROOKS F. ELLIS. *Colorimetric Method for Determination of $CO_2$ in Gas Mixtures:* DR. PERRY W. WILSON ..... 461

*Special Articles:*
*A Virus Encountered in the Study of Material from Cases of Encephalitis in the St. Louis and Kansas City Epidemics of 1933:* DR. LESLIE T. WEBSTER and GEORGE L. FITE. *The Existence of Non-chromosomal Influence in the Incidence of Mammary Tumors in Mice:* DR. C. C. LITTLE and Staff ..... 463

*Science News* ..... 6

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# FLOOD AND EROSION CONTROL AS POSSIBLE UNEMPLOYMENT RELIEF MEASURES[1]

By L. E. FREUDENTHAL

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FLOOD control and erosion control are national problems because the extent and magnitude of losses caused and control measures involved are beyond the powers of the individual states to cope with successfully. That the water problem, of which these are part, is of national scope can be shown in various ways.

Many large cities are seriously affected by the problem of getting and maintaining domestic and industrial water supplies; Boston plans to tap a stream sixty miles away; New York brings part of its supply over 92 miles; the Hetch-Hetchy Reservoir, built at a cost of $126,500,000, will furnish part of San Francisco's water supply from a distance of 200 miles; the water system of southern California will cost $350,000,000.

Irrigation water is a commodity of enormous importance to 19 states west of the Mississippi River, involving an area of 19,547,544 acres and a value in 1930 of lands, building and machinery, reservoir and distributing systems of nearly $6,000,000,000.

Water power is being utilized in practically every state. Twenty-six states, by 1931, scattered from Maine to California, have each developed over 100,000 horsepower.

The inland waterways of the country, exclusive of the Great Lakes and interior and intra-coastal canals, carried 130,000,000 short tons of freight in 1929. The War Department has spent tremendous sums in the deepening and widening of natural channels and in engineering works to make navigation possible during

[1] Address at the thirteenth annual meeting of the Southwestern Division of the American Association for the Advancement of Science, Las Cruces, New Mexico, May 1 to 4, 1933.

periods of low water. On one stream alone—the Ohio River—the army engineers spent some $118,000,000 in the building of 49 locks and dams. During the 50 years ending June 30, 1932, $844,452,177 have been spent by the Federal Government on existing river and harbor projects directly connected with stream-flow. It is interesting to note that not one cent of these millions was spent in the Colorado, Great Basin or Rio Grande drainage regions. Contrast these sums with the expenditures for reclamation in the West, which in 1930 totaled about $162,000,000. Of this amount only a little more than five million dollars is a direct appropriation from the general treasury. Surely the Western states are justified in asking for more than their per capita share of unemployment relief funds.

So much for the story of beneficial uses of water. The figures showing harmful effects of floods and erosion exceed even the values mentioned above. The Mississippi flood of 1927, which inundated 18,000 square miles, drove 750,000 persons from their homes, did some $300,000,000 worth of damage and took 246 lives, is only an instance of what is happening annually on a smaller scale in nearly every state. The 1932 floods on the Rio Grande damaged $2,500,000 worth of property and cost 12 lives. In 1927 New England floods did $35,000,000 damage to property and cost 84 lives. In the Middle West in 1913 the Ohio River damaged property worth $180,000,000 and sacrificed 400 lives. For the last 20 years flood damage in South Carolina and Tennessee has averaged nearly $1,000,000 a year.

Soil erosion is unquestionably a national menace, greater than war. Mr. H. H. Bennett, of the Bureau of Soils, U. S. Department of Agriculture, states:

> The writer, after 25 years spent in studying the soils of the United States is of the opinion that soil erosion is the biggest problem confronting the farmers of the Nation over a tremendous part of its agricultural lands. . . . Not less than 126 billion pounds of plant food material is removed from the fields and pastures of the United States every year. The value of the plant food elements in this waste is two and a half billion dollars annually. Of this amount, there is evidence to indicate that at least 200 million dollars can be charged up as a tangible yearly loss to the farmers of the Nation. Rain wash removed not only the plant food elements, but also the soil itself. The plant food elements removed by crops can be restored in the form of fertilizers, manures and soil improving crops, but the soil that is washed out of fields can not be restored except by the exceedingly slow natural process of soil building, that requires in many instances centuries to develop a comparatively thin layer.

In the high valleys of the Appalachian Mountains, on the rich bluff lands of the Mississippi as far north as Wisconsin, on the Piedmont plateau of the Southern states, in the states bordering the Ohio River, in Missouri, Oklahoma and eastern Texas, and in other agricultural sections of the United States, erosion has been the principal cause for abandoning millions of acres of cleared land. On the wide-spreading expanse of the public domain unregulated grazing has resulted in erosion, which not only has seriously reduced the value of the forage but threatens the very existence of the Western irrigation projects.

The principal factors which influence the normal division of run-off into useful subsurface waters and less useful or destructive surface waters are the character of the precipitation, the geology and topography of the surface on which it falls and the vegetative cover on that surface. The vegetative cover is the only one of these factors which it is within human power to control. Floods and erosion will continue, unless the lands are reclothed in permanent vegetation such as forest, brush or grasses, so that the soil will be held in place, absorption increased and run-off from the slopes slowed down.

National action is necessary because the extent and magnitude of control measures transcend state lines. Some control measures are properly within the province of a state or smaller political subdivision. The major control measures, however, for several reasons require federal participation. Briefly, federal participation is necessary because the beneficiaries under interstate rivers outnumber so greatly the persons living where the streams rise. In the Western states particularly, where so many streams rise on land untaxed for state purposes in the Forest Reserve or Indian reservations, it is impossible to allocate the burden on persons receiving the grazing benefits, or the lumber in reserve, or the benefits from power development resulting from flood and erosion control, since title to these lands may be kept in the Federal Government. Furthermore, sales of power may be mainly without the state, or to a municipality in another state, as in the case of the Elephant Butte Dam in New Mexico and the city of El Paso, Texas. In these public land states the private lands are a small part of the beneficiaries and can not bear the costs of control measures.

Furthermore, where control measures might be left to a country or community, there is grave danger that while the type of control measures may be satisfactory to the local region, the results may be disastrous to interests lower down on the stream. For illustration, the middle Rio Grande region around Albuquerque is menaced by a higher river bed than portions of the surrounding country. This condition could be remedied by straightening and narrowing the river channel, thereby increasing the velocity in the artificially

maintained river bed, resulting in an increased silt-carrying capacity of the river and eliminating the silted condition of the river channel at the locality. Such a policy would result in carrying the silt into the Elephant Butte reservoir, thereby decreasing its water storage capacity, and harming the farmers on the Rio Grande project. Further down the river a similar policy of channel straightening would menace agricultural lands or even cause international problems, for the Rio Grande is an international stream. The leaving of corrective measures to local authorities, I believe, should only be done in such cases where the cheapest form of relief for the locality is not hazardous to greater interests below.

The federal government, through the work of the army engineers, has proceeded on the principle of primary farm protection. Colonel T. N. Robbins, division engineer, U. S. Army Engineering Corps, in an address on "Water Storage and its Relation to Agriculture in the Public Lands States," before the Second National Waterusers Conference, stated: "In the development of both the Mississippi and the Sacramento flood control projects, the protection of agricultural land was a primary consideration. The Mississippi project will protect about 13,000,000 acres; the Sacramento project about 1,000,000 acres."

Constitutional support for federal participation in projects primarily for flood control might be found (1) in the interstate commerce clause, for the improvement of navigation where the watershed is on a navigable stream; (2) in the treaty-making power where the watershed is on an international stream in connection with which the United States has undertaken to fulfil a treaty obligation; (3) in the authority reserved to the states to enter into compacts subject to approval by Congress where the watershed is on an interstate stream, the use of which has been made the subject of such compact approval by Congress, and necessarily involves a program of flood control for the protection of that use, or uses, especially where the Federal Government owns reservoir sites and rights of ways, instrumentalities essential to the prosecution of such a program; and (4) in the authority of the United States as a proprietor to construct irrigation projects for the improvement of its public lands where the watershed is above a project already built and flood control measures would protect that project from silting or other damage from uncontrolled floods.

The primary requirements of a Federal Unemployment Relief program are: (1) the program should be national in scope; (2) it should provide for the beneficial use of large groups of unskilled labor; (3) it should provide the possibility of year-round employment. Flood and erosion control measures fully meet these requirements. The types of control measures will vary with conditions in different parts of the country. Where rainfall is abundant, replanting of trees and brush, etc., and construction of small check dams are practicable. It is only in the Southwest, however, that all-year employment can be readily provided. Therefore, I shall discuss in more detail control measures particularly adapted to southwestern conditions.

The Forest Service has submitted a statement covering the average work that might be done by a 200 man camp during six months on erosion control in the West. It is largely based on the Utah plans. It provides:

(1) About 30 miles of fencing of critical areas to control or eliminate live stock which would damage the work or which would prevent rapid natural revegetation where reseeding is not feasible.

(2) Seeding 1,000 to 1,200 acres (some camps in Utah and further north under favorable soil and moisture conditions may have 4,000 or more acres seeded). Grasses or other plants suitable for the specific soil and moisture conditions should be used. If there are native plants with rootstocks available in the locality digging and replanting of these on the eroded areas should be considered. Trees should be used where they can be effectively planted and where stock is available. Collection of seeds of suitable native plants should be included in the revegetation plans and such seed used for reseeding purposes this fall or next year. This would apply, for example, to native mountain brome and violet wheat grass, which have proven successful for seeding in central Utah.

On steep slopes a contour furrow should be plowed to give a base for seeding, and to catch seed which washed down from the face of the slope. The contour furrows will be necessary for the seeding of yellow sweet clover, since it should be seeded only on exposed soil.

(3) Small check dams of local rock, brush or mesh wire in active gullies.

(4) Cutting and throwing brush into small gullies and in large gullies between the check dams.

Modifications of this plan for the Southwest would provide probably larger amounts of fencing and smaller amounts of seeding. The experimental results of artificial reseeding in southern New Mexico do not seem sufficiently conclusive to make advisable a recommendation of extensive planting. However, where the rainfall is 20 inches or more, as in the northern part of New Mexico, artificial reseeding with such plants as blue grass, white clover, orchard grass, timothy and smooth brome should be experimented with.

I believe that immediate flood control measures may well come before long-time erosion prevention measures, particularly in the light of furnishing relief for unemployment.

A broad statement of the theory on which flood control measures are based might be that the control measures are designed to check the velocity of the flow of water. Among the important reasons why checking the velocity is important are: (1) checking just a little of the velocity diminishes the debris carrying power of the current a great deal (to either the 5th or 6th power); (2) when a stream is laden to capacity with boulders, silt, gravel, logs and brush, the ordinary channel is rapidly filled and the stream floods over the banks, thereby damaging the surrounding country; (3) checking the velocity increases absorption owing to the greater clarification of the water; it increases absorption due to increased time of discharge; it increases absorption due to increased head produced by bays back of the check structures; it increases the absorption by increasing the wetted perimeter of the stream; in fact, it enables nature to recover herself from the spoliation of the forces of waste and to build up again the fern and willow growth and to recreate the moisture-filled soil storage that all through the dry season should be furnishing its little quota of flow to the river below.

Since, on large areas of southwestern desert land the rock and brush commonly recommended for the construction of small check dams are not available, I suggest the use of earth-filled sacks in small gullies. These sacks will retain the dam for two or more years. My experience on a farm near Dona Ana, New Mexico, subject to arroyo floods, indicates that our rains in southern New Mexico are very spotted and that floods of sufficient size to wash out these bags of earth will not be wide-spread over a long period of time. On that farm the arroyo has run only 4 times in 18 years. These bag dams should serve long enough to check a considerable quantity of silt and perhaps permit the growth of native vegetation in their vicinity. On a farm in Arizona, using check dams and transplanted willows, I filled level in 4 years a 3,000 yard gully which had been from one to ten feet deep and three to five feet wide.

I desire also to suggest the possibility of utilizing labor in planting Tamarisk or similar plants at the inflow of large reservoirs, such as Elephant Butte or Roosevelt Lakes. It has been found on Lake McMillan that this plant made a dense growth, varying in diameter from the size of a pencil to 6 or 8 inches. There it caused heavy deposition of silt, thereby preventing a reduction in the water storage capacity in the reservoir through silting.

I think also it would be possible to establish small rodent-proof seeding areas, wherein native grasses and shrubs would reproduce their seed, which would be wind-sown.

Another means of using unemployed labor is in the development of additional underground water supplies on our grazing areas. Dr. William Peterson, in an address before the 3rd Water Users' Conference of the American Farm Bureau Federation, stated:

> The development for stock water over our grazing areas is going to become an important problem. Even in the face of an extreme drought as the country faced in 1931 when grazing was scarce, hundreds of square miles of good grazing areas went untouched because of lack of water supply. Experiments in grazing work indicate that an animal might walk two and one-half miles to water and still continue to gain. This means that one watering hole might serve an area of as much as 20 square miles. A stream of 10 gallons per minute would be sufficient to supply 1,000 head of cattle. For such service pumping of great depth may be permissible.

There is no question in my mind but that federal control of the public domain, preferably under such an agency as the Forest Service, is indispensable to the solution of the erosion problem. Such control would permit regulation of grazing. Under such a plan, much winter work could be done on telephone lines, fire protection, roads and trails, headquarter stations, fencing for management of stock, water development, as mentioned above, and revegetation and erosion control.

One further line of work which, it seems to me, might be developed is in the poisoning of rodents on the range. It has been shown on the Jornada Range Reserve that these rodents eat great amounts of the feed, and where the stand is scant, they even overgraze the range. However, I am not certain what the probable ecological upset would result in.

A final suggestion is the possibility of using unemployed labor in straightening the channels of large arroyos and widening the channels where the construction causes the arroyo floods to overflow and damage adjoining farm lands, as does the San Simon arroyo in Arizona.

In conclusion, I believe that flood and erosion control are ideally suited for unemployment relief measures, because the control would be reasonably effective, but principally because of the possible excellent effect upon the unemployed themselves. The spirit behind these ideas was phrased as early as 1919 by Frank H. Olmstead, who, in a report on the Gila River flood control, wrote:

> The building the small retarding structures must proceed without plans and specifications and preferably should be handled by force account, using young, active men interested in conservation work. If there could be a great army of the youth of the Nation encamped in the glorious mountains of the upper Gila and in the wonderful canyon lines of the Mogollon, Black, San Francisco, and

Tularosa Mountains, for, say, one year, under competent instructors and subjected to drill and obedience not alone in the use of arms but of tools and in building some hundreds of thousands of these little structures, the young men would be better off and the Nation wonderfully enriched. There would be recreation and sport of occasionally killing a black tailed deer or a wild turkey or the gray squirrels, which we saw almost every hour of every day while in this region. Our national life would not only be reinforced through a pronounced conservation achievement along material lines, but the spirit of true national defense would have a new birth.

# RESEARCH WITH A HEN[1]

By Professor F. B. HUTT
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THE subject of this address was unwittingly suggested by a member of the board of governors of one of the largest universities in the United States. This institution employs upwards of two hundred graduate students as assistants in research and in teaching, but when the board was requested a few years ago to appoint a research assistant in the Department of Poultry Husbandry, it was confronted with a situation quite unprecedented in all the years of the university's existence. It was not surprising, therefore, that one member of that body should have expressed his doubt about the desirability of the proposed new appointment, but it was surprising that he should do so by asking the very pointed question, "What research can you do with a hen?"

What research can you do with a hen? Among the members of this society there are over a hundred who could answer this question by quoting investigations now under way in the various universities and experiment stations which they represent, and concerned with the nutrition, genetics, physiology, embryology, pathology, parasitology or psychology of the fowl. These experiments are planned in nearly every case to discover new facts and to add to our store of knowledge. It is because such investigations have been carried on for many years that we now have a sufficiently great accumulation of facts to justify the designation of this branch of knowledge as poultry science.

To discuss research intelligently we must have an understanding of what the word implies, but, in attempting to define it, no one realizes better than I the difficulty of giving any arbitrary and fully satisfactory definition. As every director of an experiment station knows, there are investigations of divers kinds, not all of which are entitled to be designated as research. Some are merely *re*-search, but, in so far as they improve upon previous methods and by so doing establish new facts or provide more accurate interpretations, such investigations may fairly be classified as research. This can hardly be said, however, for the all-too-common repetition of experiments in which the results have been so conclusive that additional substantiation is entirely unnecessary. Nor can we classify as research those investigations in which sources of error and of environmental modification of results have been so ill controlled that no definite answer to the original problem is provided by the experiment. Fortunately such experiments are becoming fewer.

The majority of our experiments, however, are set up to determine new facts about the hen and about other domesticated birds. Except for studies of costs of production, which are largely economical rather than biological in nature, our investigations are concerned with the hen's nutritional requirements, her physiology, her genes and the characters they produce, her embryonic and postnatal growth, the parasites that beset her, the bacteria that invade her and, withal, the mental processes that are responsible for her often inexplicable peculiarities of behavior. In pursuing these researches we usually apply already well-known principles of nutrition, physiology, genetics, embryology, parasitology, bacteriology and animal psychology. We are not concerned primarily with extending the boundaries of these fields of science, but rather with utilizing them to give us more information about the fowl. However, if an investigation adds one small fact to the already large amount of knowledge about the hen, that investigation is undoubtedly research so far as poultry science is concerned. It may also be called research in nutrition, genetics or any of the other sciences, if it extends to a new species the application of a principle not yet known to have universal application.

But there is still another kind of research with a hen, a kind which has not been adequately appreciated even by members of this association, and certainly not by the gentleman who asked, "What research can you do with a hen?" I refer to those investigations in which the hen has been used, not for the application of existing principles, but for the discovery of entirely new concepts in biological science.

[1] Address of the president at the twenty-fifth annual meeting of the Poultry Science Association, East Lansing, Michigan, August 2 to 5, 1933.

To begin with, our whole knowledge of early embryology of vertebrates rests largely upon the great body of facts which has been accumulated about the development of the chick. As early as the fifth century B. C., Hippocrates, the father of medicine, was advising his students to verify his teachings of human embryology by daily examination of incubating eggs from the second day to hatching and assuring them that therein "you will find everything as I say, in so far as a bird can resemble a man." Twenty-three hundred years later I send many dozens of eggs each year to the modern disciples of Hippocrates at our university in order that they may do just what he directed.

A century after Hippocrates, Aristotle wrote a description of the development of the chick embryo which was so remarkably accurate that little improvement was made upon it until the work of Fabricius ab Aquapendente early in the seventeenth century. Nevertheless, up to the time of William Harvey (1578–1657) there was no clear conception of where or from what materials the embryo of either birds or mammals began its development. It remained for that scientist to show that in the hen's egg the little light spot on the yolk, which he called the cicatrula, and which we call the germinal disk, or blastoderm, was the original center of growth. It was not a far cry from this discovery to his all-important doctrine of *ex ovo omnia*—"all things come from eggs." It is interesting to recall that Harvey, whose demonstration of the circulation of the blood marked perhaps the greatest single advance that physiology has ever known, was a keen student of the embryology of the chick, and that his "Anatomical Exercitations on the Generation of Animals" was based almost entirely on his observations of chick embryos.

A little later, under the microscopes of Malpighi, the chick afforded to man his first view of the neural groove, the somites and the optic vesicles, characteristics of all vertebrates at early stages of their development. Malpighi's studies, published in 1672, may be said to have established the chick as the animal *par excellence* for both microscopical and macroscopical studies in embryology, and, in succeeding years, with its aid, Wolff, von Baer, Balfour and others laid the foundations of our present detailed knowledge of embryonic development A glance through any current journal of zoology or anatomy will show that the chick's usefulness in this field is by no means ended.

If the chick has been of service in revealing the processes of normal development, it has been of equal value in the experimental study of teratology or abnormal development. The difficulties of experimental manipulation of mammalian embryos are obvious. On the other hand, the chick embryo is ideal for this purpose, because, in the words of Dareste, "the fertilized ovum is endowed by fertilization with the capacity for development, it is separated completely from the maternal organism; it results therefrom that the egg which contains it can be submitted to all the influences which we believe capable of modifying its development." It is not surprising, therefore, that the chick embryo should have been utilized by Geoffroy Saint-Hilaire, one of the founders of teratology, or that Dareste should have devoted practically his whole life to the experimental study of abnormal development in the same species. To-day the more recent science of experimental embryology, the "Entwicklungsmechanik" of Roux, counts the chick embryo among its most useful subjects for research.

Man's knowledge of the physiology of reproduction was greatly clarified by two important advances at the close of the seventeenth century. One of these was the discovery of mammalian ova by De Graaf in 1672; the other occurred two years later, when a Dutch medical student, Ham, saw for the first time the myriads of minute animalculae which we now know as spermatozoa. Professor Punnett quotes Fridericus Shrader as authority for the statement that these were first detected by Ham in the semen of a male fowl. This seems not unlikely, for in 1677 in one of his numerous letters to the Royal Society of London, Leeuwenhoek, to whom Ham had revealed his discovery, stated that he had been able to find in the semen of a cock a "huge number of little snakes or eels," which were not to be found in the material from hens. Ham's discovery was the result of a decidedly valuable research in which the fowl proved to be a most useful animal.

The contributions of the fowl to science thus far mentioned were mostly made before the eighteenth century. To show you that the hen is still in the rank as a laboratory animal, I should like to describe a few more recent important advances in which she has played a part.

It is doubtful if the world has seen any more dramatic demonstration of a scientific fact than that given by Pasteur in 1882 at the farm of Pouilly le Fort, near Melun in France. The great scientist had offered to convince a skeptical world that he could make animals resistant to anthrax, a disease which up to that time was rightly considered as one of the worst scourges afflicting domestic animals. Twenty-five sheep were inoculated twice with attenuated organisms of the kind causing anthrax, and twenty-five others were set aside as controls. Subsequently, all sheep in both lots were given a virulent dose of the organism. Within five days every control sheep was dead, but of the twenty-five that had been inoculated

all were in perfect health except one that died from conditions associated with pregnancy. The potentialities of vaccination were established.

Let us remember, however, that this dramatic and convincing experiment would not have been possible if Pasteur had not first discovered that the deadly organisms could be attenuated, or weakened, until they were capable of causing only a mild infection to which the body could speedily build up a resistance. This fundamental discovery was made not with *Bacillus anthracis,* but with the organism causing fowl cholera. It was the discovery that aged cultures of this bacterium produced only mild and temporary symptoms of the disease that led Pasteur to the successful use of attenuated organisms as a means of building up resistance to anthrax and, later, to other diseases. Research with a hen has not been barren in the field of bacteriology.

Let us consider endocrinology, probably of all the biological sciences the field of greatest activity at the present time. It is well known that the secondary sex characters of the fowl are easily modified by subjecting them to the influence of hormones of the male or female gonads, or by complete gonadectomy. Moreover, the feather follicle can be used to excellent advantage as an indicator of thyroxine. For these reasons the fowl has been selected as a favorable subject for the study of sex and secondary sex characters by research laboratories in Chicago, Edinburgh, Strasbourg and Moscow, as well as by numerous individual workers. Apart from all the present activities, however, let us keep in mind that the first actual demonstration that there was any such thing as an endocrine secretion was made by Berthold in 1849, when his transplantation of testes of the fowl was followed by typical male-like growth of the comb in the recipients. It is true that Berthold, like many another investigator, did not fully appreciate the significance of his discovery at the time, but that does not vitiate the importance of his research as the first step in the now tremendously complicated field of endocrinology.

The Dutch physician, Eijkman, is justly famous for his experiments in 1897 in the etiology of beriberi. It should be remembered that these investigations were prompted by his discovery that fowls fed the garbage from the hospital of the Javanese prison, at which he was medical officer, contracted a paralysis very similar to that afflicting his patients. This led him to conduct experiments in which some fowls and pigeons received rice with the outer layer left upon it, while others were given only polished rice. When the latter group contracted the degeneration of peripheral nerves, which Eijkman designated as *polyneuritis gallinarum,* it was the first time in history that a disease of dietary origin had been experimentally produced. It is little wonder that Eijkman's findings should be hailed by Dr A. V. McCollum as "the most remarkable observation in the history of beri-beri, and the one which inaugurated the modern era of investigations in the field of nutrition." Obviously, research with a hen has been decidedly worth while in that branch of science.

In the field of genetics, the fowl has been so extensively studied that more is known about its inheritance than that of any other domestic animal. This is not surprising, partly because of its more rapid rate of reproduction, but also because the domestic fowl was the first species to bear witness that Mendel's laws apply to the animal kingdom.

When William Bateson presented to the Evolution Committee of the Royal Society his initial report on "experimental studies in the physiology of heredity," covering extensive researches with four species of plants and with poultry, that document included sufficient data to show conclusively that rose comb, pea comb and the dominant white of White Leghorns were simple dominant characters, segregating in a 3:1 ratio in the $F_2$ generation and in a 1:1 ratio in back-crosses. It is important to remember that this report was presented on December 17, 1901, and that the experiments were begun in 1898. It is difficult to escape the conviction that, if Mendel's laws had not been rediscovered in 1900 by De Vries, Correns and von Tschermak, they would have been worked out independently by William Bateson. It has well been said that, were it not for Mendel, Bateson might be sleeping in Westminster Abbey.

From this auspicious beginning the fowl has continued to provide valuable material to the geneticist, including one of the first cases known of sex linkage, the first experimental demonstration in domestic animals of the possibilities of reducing losses from disease by breeding resistant strains, unrivaled evidence of the value of the progeny test, information about the phenomenon of crossing-over in females having only one sex-chromosome, to say nothing of the variety of morphological characters, which, I venture to predict, will some day be utilized to find out how the gene gives rise to the character, a field of genetics as yet practically unexplored.

More of these examples might be given, but I have cited enough to show that the hen has a right to stalk with pride through almost any biological laboratory, whatever its particular fields of activity may be. Nor has she shown the narrow specialization of Drosophila, of the albino rat, or the guinea-pig, whose spheres of usefulness are largely confined to the re-

searches of the geneticist, the nutrition specialist or the bacteriologist, respectively. She is, withal, a lass of many parts.

As poultrymen we respect the hen as being of all domestic animals the most efficient converter of raw materials into edible food stuffs. We respect her as one of the most profitable sources of farm revenue, the mainstay of many a farm home where crops have not yielded the promise of spring. As biologists, let us also respect her as one to whom science owes no inconsiderable debt of gratitude. It is fitting that we should draw on all the resources of science to keep her in a state of maximum efficiency, to prolong her useful life, to prevent the ills to which she is subject and to raise her progeny with a minimum of loss. By so doing we make some slight return for the contributions to knowledge which have resulted from "research with a hen."

# SCIENTIFIC EVENTS

## THE ALGERNON FIRTH PATHOLOGICAL INSTITUTE AT THE UNIVERSITY OF LEEDS

*The British Medical Journal* reports that the recently opened Algernon Firth Pathological Institute in Leeds will include the university departments of pathology, bacteriology and cancer research, thus coordinating investigation and teaching, as well as facilitating the application of new scientific discoveries to the social and industrial needs of the community. Including its equipment, the provision of the building has cost approximately £50,000. Half this sum was offered by Sir Algernon Firth, at the instigation of Lord Moynihan, on condition that in the new building there should be suitable accommodation for cancer research. Sir Algernon, who opened it, mentioned that he fully realized the continuing value to humanity of a research building under the control and care of so permanent an organization as the University of Leeds. Cancer research might diminish or even terminate with the attainment of success in its objective, but the need for persistence in other investigations to reduce the sum of human unhappiness would still remain. The pro-chancellor, Colonel C. H. Tetley, accepting the definition of the Firth Institute as the keystone of a structure which had been built up gradually, insisted that the achievement had only been rendered possible by the collaboration with the University of the City Council, the General Infirmary and other Leeds hospitals, and the Yorkshire Council for Cancer Research. He hoped that the one remaining unfinished part of the scheme, namely, the furnishing and equipping of the pathological museum, would be accomplished before long by yet another instance of cooperation. Professor Robert Muir, of Glasgow, summing up the outlook of the institute, said that, since it was impossible to vest in one person both clinical knowledge and the faculty of applying scientific methods, the information resulting from these two lines of observation should be fused so far as was possible. The institute would make it one of its obligations to promote the close cooperation of physicians and surgeons with laboratory investigators, involving an interchange of ideas, and would combine routine hospital pathological inquiries, teaching and research. The number of problems capable of being attacked by independent workers was rapidly diminishing. The many problems that remained demanded a combined effort on the part of workers possessing very different scientific qualifications. Cooperation and organization, Professor Muir added, were becoming more and more essential, and there was no disease which could not be more clearly elucidated thus. The determination of the presence of cancer in its earliest stage in any part of the body was a goal which was being keenly approached by workers starting from various points and applying different branches of scientific research. Vast benefits would accrue to the whole community when these coordinated, though very diverse, activities attained their joint objective.

## JUNIOR SCIENCE CLUBS OF THE AMERICAN INSTITUTE

THE American Institute's Junior Science Clubs held three meetings on Saturday morning, November 4, for its seven thousand members, all of whom are under eighteen years of age. The meetings, centering about the general themes of biology, physical science and general science, attempted to make some real contribution to the individual interests of each of the two hundred member clubs.

These three meetings, on different science subjects, are a part of a plan to assist the "young scientists" of the city. The speakers, all of whom are well known in their different fields, agreed to devote the morning to the presentation of phases of science which the junior clubs could, themselves, begin work in. The talks were planned to lift science above the routine of the classroom and to demonstrate to the children its place in their own lives. The chairmen of the divisions, with the speakers and their subjects, follow:

At the College of the City of New York: Junior Science, *chairman,* Mr. Alfred Knight, vice-president of the American Institute, fellow of the Royal Astronomical Society. Speakers: Dr. Raymond L. Ditmars, curator

of reptiles and mammals, New York Zoological Park, "Strange Animal Friends." Dr. Ditmars illustrated his talk with three reels of motion pictures, taken by himself, and told of his recent trip to the American tropics in search of vampire bats. Mr. Merwin M. Peake, founder of the Junior Air Squadron of Elizabeth, New Jersey, "Junior Aeronautics for Science Clubs." Illustrated with actual airplane models and with motion pictures and slides. Several boys from his own "Air Squadron" were given ground tests before the audience.

At the New York Botanical Garden: Senior Biology, *chairman,* Dr. William Crocker, director, Boyce Thompson Institute for Plant Research, Yonkers, New York. Speakers: Dr. E. D. Merrill, director, New York Botanical Garden, "The Origin of Our Cultivated Food Plants." Robert F. Light, biochemist, research staff, Fleischmann Laboratories, "Clinical and Experimental Phases of the Study of Vitamins." For this group the botanical gardens arranged special exhibits of food plants from all over the world.

At the College of the City of New York: Senior Physical Science, *chairman,* Dr. Morris Meister, of the Plan Committee for the Junior Science Clubs. Speakers: Dr. Lincoln T. Work, School of Engineering, Columbia University, "The Significance of Fine Particles in Chemical Engineering." Professor Parke B. Fraim, physics department, Polytechnic Institute of Brooklyn. Professor Fraim's talk was similar in character to his "Twenty Demonstrations in Twenty Minutes," a lecture given recently for teachers of science.

## THE THIRD TECHNICAL AND CHEMICAL INTERNATIONAL CONGRESS OF AGRICULTURAL INDUSTRIES

THE United States has been invited by the Ministry of Agriculture of France to participate in the third Technical and Chemical International Congress of Agricultural Industries, which will be held in Paris, during the week of March 26, 1934. Upon the recommendation of the Secretary of Agriculture, Dr. Atherton Seidell was designated to represent the United States on the Committee of Organization of this congress which met in Paris on July 10 last. At that time the regulations and a tentative program of scientific activities were adopted. Twenty sections covering most branches of agricultural chemistry have since been organized and a number of questions proposed which will form the subjects of a series of symposia.

Dr. C. A. Browne, chief chemist of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, has addressed the letter given below to scientific men who may wish to attend the congress.

The central organizing Committee of the Congress desires that as large a representation from America as possible be present and participate to the fullest extent in the activities of the congress. Due to the short time which remains it is not possible for the Paris Bureau of the Congress to send invitations direct to persons, institutions, societies, commercial organizations, etc., in the United States. We have, therefore, been requested to bring the subject to the attention of all who may be interested.

This letter should be considered as a personal invitation to you and other representatives of your group to take part in the congress and, if possible, submit communications which may be placed on the program of the meeting.

The date has been advanced to March 26 to 31, inclusive, to permit those who attend the Paris Congress to reach Madrid in time (April 5) for the Ninth International Congress of Pure and Applied Chemistry.

An invitation to attend the Madrid Congress has also been cordially extended by the Spanish organizing committee to all American chemists, and you will consequently be able to attend two important world congresses of chemistry within a period of three weeks. This is an exceptional occasion and American chemists should certainly make an effort to take advantage of it.

Upon request to this office copies of the regulations and general organization of these congresses as well as application forms for membership will be sent.

We trust that you will cooperate with us in bringing the matter to the attention of any one who may be interested and call upon us for any further information you may desire.

## THE CINCINNATI AND BOSTON MEETINGS OF THE AMERICAN PHYSICAL SOCIETY

THE one hundred and eighty-seventh meeting of the American Physical Society will be held at the University of Cincinnati on Friday and Saturday, December 1 and 2.

This meeting will celebrate the opening of the new Physics Building at the University of Cincinnati. Special features of this meeting are the inspection of the Basic Science Laboratories and a joint meeting with the American Mathematical Society in a symposium on "Spinor Analysis." The addresses at this symposium will be made by Professor Otto Laporte, of the University of Michigan, and Professor Oswald Veblen, of the Institute for Advanced Study at Princeton.

On Friday evening at eight o'clock there will be a dinner for the members of the American Physical Society and their friends at the Netherland-Plaza Hotel. A luncheon for mathematicians and mathematical physicists will be held at 12:30 on Saturday at Mecklenburg's restaurant.

The preliminary arrangements for the Boston meeting, to be held on December 28, 29 and 30, include a joint session with the American Mathematical Society at the time of the Josiah Willard Gibbs Lecture, and a joint session with Section B of the American Association for the Advancement of Science and the Amer-

ican Meteorological Society, at which time the retiring vice-president of Section B, Professor D. L. Webster, will deliver an address on "Current Progress in X-Ray Physics." A symposium has been arranged on the positron, at which the speakers will be Professor Carl D. Anderson, Dr. J. R. Oppenheimer and Professor George E. Uhlenbeck.

The Parker House, at Tremont and School Streets, has been selected for hotel headquarters for the American Physical Society at Boston.

Other meetings for the current season are as follows:

New York City, February, 1934. Joint meeting with the Optical Society of America.
Washington, April, 1934.
Berkeley, California, June 18 to 23, 1934.

## THE NEW CHIEF OF THE BUREAU OF PLANT INDUSTRY

THE appointment of Knowles A. Ryerson as chief of the Bureau of Plant Industry, effective January 1, has been announced by Secretary of Agriculture Henry A. Wallace.

Mr. Ryerson will succeed Dr. W. A. Taylor, who retires the first of the year after forty-two years' service with the Department of Agriculture, twenty of which have been as head of the bureau. Dr. Taylor reached the retirement age on July 1, but the President granted an extension of six months at the urgent request of Secretary Wallace.

Mr. Ryerson is now in charge of the Division of Foreign Plant Introduction, Bureau of Plant Industry. His promotion to the position as chief of the bureau is announced now so that he may have an opportunity to work for the next few weeks with Dr. Taylor on budgetary and administrative problems before he assumes his new responsibilities.

Knowles A. Ryerson was born on October 17, 1892, at Seattle, Washington. He received his degree of bachelor of science from the University of California in 1916, and a master of science degree from the same university in 1924. He was with the agricultural extension service of the University of California from 1919 to 1925, first as assistant state club leader, and later as assistant farm adviser and farm adviser of Los Angeles County.

From 1925 to 1927 Mr. Ryerson was in Haiti as horticulturist on the staff of the Agricultural Experiment Station. For seven months in 1927 he was horticulturist with the Joint Palestine Survey Commission in Palestine and Transjordania, after which he became head of the Division of Foreign Plant Importations in the Bureau of Plant Industry. His search for plants that would be economically advantageous to this country have taken him to Canada, Spain, Morocco, Algiers, Tunis, Sicily and other countries.

From 1917 to 1919 Mr. Ryerson served with the Forest Engineers Branch of the A.E.F. in France. He was on the staff of agricultural damage investigations section of the American Peace Commission from January to March, 1919, and agricultural officer at the American embarkation center in France from March to June, 1930. For his service in France he received the decoration of Chevalier du Mérite agricole from the French Government.

Dr. William A. Taylor entered the United States Department of Agriculture as assistant pomologist in 1891. He was born in Chelsea, Michigan, on June 23, 1863. He received the degree of bachelor of science from Michigan State College in 1888, and then served for three years as manager of a Michigan fruit farm and nursery before going to the department. He received the degree of doctor of science from Michigan State College in 1913.

Dr. Taylor became pomologist in charge of field investigations for the Bureau of Plant Industry in 1901 and continued in this position until 1910, when he was appointed assistant chief. After three years in this position he became chief of the bureau. He is the author of numerous bulletins and articles, and has delivered addresses before horticultural and pomological societies.

In 1900 Dr. Taylor served as an expert in horticulture with the U. S. Commission to the Paris Exposition and was a member of the International Jury on fruit trees and fruit. In 1904 he served as a member of the International Jury of the Department of Horticulture at the St. Louis Exposition, and in 1918 was a member of the Agricultural Commission to Europe.

## RECENT DEATHS

DR. FREDERICK LINCOLN CHASE, assistant astronomer at the Yale Observatory from 1890 to 1910 and acting director from 1910 to 1913, died suddenly on November 8. He had been residing at Boulder, Colorado, where he was born in 1865.

DR. JAMES EDWARD TALMAGE, formerly president and professor of geology at the University of Utah, died on July 27, at the age of seventy years. Dr. Talmage was a member of the Royal Society of Edinburgh and the Geological Society of London and was a life member of the American Association for the Advancement of Science.

WILLIAM DE CHASTIGNIER RAVENEL, retired administrative assistant to the secretary of the Smithsonian Institution, director of arts and industries of the U. S. National Museum and a former secretary of the

American Association of Museums, died on October 8 at the age of seventy-four years.

SIR GEORGE HENRY MAKINS, London, formerly president of the Royal College of Surgeons, died on November 2 at the age of eighty years.

THE death is announced of Professor Wilhelm Mielck, director of the State Biological Institute at Helgoland.

SENATOR PIETRO ALBERTONI, formerly professor of physiology at the Universities of Genoa and Bologna and a member of the physiological section of the Reale Accademia Nazionale dei Lincei, died on November 8 at the age of eighty-four years.

# SCIENTIFIC NOTES AND NEWS

IT was announced from Stockholm on November 9 that the Nobel Prize in physics for 1932 has been awarded to Dr. Werner Heisenberg, professor of theoretical physics at Leipzig; for 1933 it has been divided between Dr. Erwin Schrödinger, professor of theoretical physics at Berlin, and Dr. Paul Adrien Maurice Dirac, Lucasian professor of mathematics at the University of Cambridge.

THE Copley Medal of the Royal Society has been awarded to Dr. Theobald Smith, emeritus member of the Rockefeller Institute, director of the department of animal pathology at Princeton, N. J., from 1915 to 1929, in recognition of his work on the comparative etiology, pathology and immunology of infections and parasitic diseases.

THE Wellcome Prize, including the Wellcome Gold Medal, for 1933 has been awarded to Major Edgar Erskine Hume, Medical Corps, U. S. Army, librarian of the Army Medical Library, Washington, for his essay on "The Value of Studies in Health and Sanitation in War Planning." The Wellcome Prize and Medal were established by Sir Henry S. Wellcome, London, in 1916, and are awarded annually through the Association of Military Surgeons of the United States.

A DINNER in honor of Dr. George H. Bigelow, formerly state health commissioner of Massachusetts, and Dr. Henry D. Chadwick, his successor, was given by the Massachusetts Tuberculosis League on October 26. Dr. Bigelow is now director of the Massachusetts General Hospital, succeeding Dr. Frederic A. Washburn. Dr. Chadwick was formerly controller of the tuberculosis division of the Detroit Health Department.

THE degree of doctor of engineering was conferred upon Orestes H. Caldwell, editor of *Electronics* and president of the New York Electrical Society, by Purdue University, on November 4. Mr. Caldwell served as a member of the original Federal Radio Commission. He is a director of the Institute of Radio Engineers, a past-chairman of the New York Section of the American Institute of Electrical Engineers, a member of the committees on communications and radio of the American Engineering Council, and a trustee of the New York Museum of Science and Industry.

DR. FRIEDRICH BERGIUS, of Heidelberg, has been elected an honorary member of the Institute of Petroleum Technologists, London.

OFFICERS of the New Mexico Association for the Advancement of Science, which met in Albuquerque, New Mexico, on November 2 and 3, were elected as follows: *President,* Dr. H. C. Gossard, president of New Mexico Normal University, Las Vegas; *Vice-president,* Mr. E. R. Harrington, instructor in chemistry, Albuquerque High School; *Secretary,* Dr. Stuart A. Northrop, professor of geology, University of New Mexico; *Treasurer,* Mr. Reginald G. Fisher, Laboratory of Anthropology, Santa Fé; *Editor,* Dr. Sterling B. Talmage, professor of geology, New Mexico School of Mines, Socorro. The program, in addition to technical papers, included the formulation of definite plans for expanding the activities of the association, particularly along the lines of aiding increased participation by high schools within the state.

AT the recent annual meeting of the Royal Society of Edinburgh, the following council was elected: *President,* Sir E. A. Sharpey-Schafer; *Vice-presidents,* Dr. J. B. Clark, Professor James Ritchie, Sir Thomas H. Holland, the Honorable Lord Sands, Professor C. G. Darwin, Professor R. A. Sampson; *General Secretary,* Professor J. H. Ashworth; *Secretaries to Ordinary Meetings,* Professor F. A. E. Crew and Professor James P. Kendall; *Treasurer,* Dr. James Watt; *Curator of Library and Museum,* Professor D'Arcy W. Thompson; *Councillors,* Professor P. T. Herring, Professor T. M. MacRobert, Professor Godfrey H. Thomson, Dr. Malcolm Wilson, Professor E. B. Bailey, Professor J. C. Brash, Professor A. J. Clark, Professor A. G. Ogilvie, Professor E. M. Wedderburn, Lieut.-Col. A. G. M'Kendrick, Professor James MacKinnon and Professor W. Peddie.

DR. GRIFFITH CONRAD EVANS, professor of mathematics at Rice Institute, Houston, Texas, has been ap-

pointed to succeed M. W. Haskell, professor emeritus of mathematics at the University of California, who retired at the end of the past year.

DR. HARRY BEAL TORREY, who for the past five years has been associated with the Health Service at Stanford University, has been appointed professor of biology in the School of Biological Sciences.

RECENT changes in the faculty at the University of Cincinnati College of Medicine include: Dr. Lee Foshay, associate professor of research bacteriology; Dr. Josef Warkany, assistant professor of pediatrics; Dr. Louis G. Hermann, assistant professor in the department of surgery. Promotions are as follows: Dr. Frank E. Stevenson, to associate professor of pediatrics; Dr. Waldo E. Nelson, to assistant professor of pediatrics; Dr. Johnson McGuire, to assistant professor of medicine. Dr. Nathan Chandler Foot has resigned as professor of pathology to go to Cornell University Medical Center, New York.

AT the University of London the following titles have been conferred in respect of posts held at the colleges indicated: Professor of malarial studies, Sir Samuel Rickard Christophers, London School of Hygiene and Tropical Medicine; reader in pathology, Dr. F. A. Knott, Guy's Hospital Medical School; reader in zoology, Dr. A. J. Grove, East London Medical College.

PROFESSOR ADOLF FRAENKEL, of Kiel, has been appointed to a chair of pure mathematics in the Einstein Institute of Mathematics at the Hebrew University in Jerusalem.

PAUL MARSHALL REA has been appointed director of the Santa Barbara Museum of Natural History. Mr. Rea was formerly director of the Charleston Museum and the Cleveland Museum of Natural History and consultant to the Advisory Group on Museum Education of the Carnegie Corporation. Harold Sidebotham, acting director since August, 1932, remains on the staff of the museum as research associate in biology.

DR. W. F. GEDDES, associate professor of chemistry at the Agricultural College of the University of Manitoba, Winnipeg, has been appointed chemist in charge of the Dominion Grain Research Laboratory, Winnipeg, Canada. For two years Dr. Geddes has been chairman of the Committee on Standardization of Laboratory Baking of the American Association of Cereal Chemists.

THE British Medical Research Council has appointed Professor E. P. Cathcart, of the University of Glasgow, to be chairman of the Industrial Health Research Board in succession to Sir Arnold T. Wilson, who has resigned on becoming a member of Parliament. Professor Cyril Burt and Miss Hilda Martindale have been appointed members of the board in succession to Sir John H. Parsons, and Miss M. Ritson, who have retired in rotation.

DR. M. V. GOVINDASWAMY, on leave from the University of Mysore, India, is spending the current year at the Worcester, Mass., State Hospital. He is collaborating in the research activities of this institution and making a study of psychiatric practise in the United States.

PRESIDENT KARL T. COMPTON, of the Massachusetts Institute of Technology, will deliver the Alexander Van Rensselaer Lecture at Drexel Institute on December 6. His subject will be "Possibilities and Difficulties of High Voltage Engineering." The Van Rensselaer Lectures were established by the Board of Trustees of Drexel Institute during the past year in honor of Alexander Van Rensselaer, son-in-law of Anthony J. Drexel, founder of the Institute, and for many years president of the Board of Trustees.

DR. ARTHUR B. DUEL, of New York, will deliver the annual Mutter lecture at the College of Physicians of Philadelphia on December 6. He will speak on "The Pathology and Surgical Treatment of Facial Paralysis."

PROFESSOR ARTURO CASTIGLIONI, professor of the history of medicine at the University of Padua, gave a lecture on November 2 at the Cornell University Medical College, on "The Medical School at Padua and the Renaissance of Medicine."

PROFESSOR OTTO H. WARBURG, director of the Kaiser Wilhelm Institute for Cell Physiology, Berlin-Dahlem, and winner of the Nobel Prize in medicine in 1931, delivered an address on physiology at Columbia University College of Physicians and Surgeons on October 23.

DR. OTTO LOUS MOHR, professor of medicine at the Royal Frederiks University, Oslo, will give the Edward K. Dunham lectures at the Harvard Medical School on November 20, 22 and 24. The general subject of the series is "Genetics and Pathology."

DR. HERBERT E. IVES, of the Bell Telephone Laboratories, New York, delivered the Thomas Young oration before the Physical Society at the Royal Institution, London, on October 6. Dr. Ives' subject was "Thomas Young and the Simplification of the Artist's Palette."

DR. E. H. R. HARRIES has been appointed by the Royal College of Physicians Milroy lecturer for 1935.

THE Society of American Bacteriologists will hold its annual meeting in Philadelphia from December 27 to 29, inclusive, under the presidency of Dr. W. Mans-

field Clark, of the Johns Hopkins University School of Medicine. The scientific program will include groups of papers on viruses, the chemistry of antigens, industrial fermentations, mastitis and the decomposition of soil organic matter. The group of papers on industrial fermentations will include important contributions by both American and foreign workers. Round table discussions will be held on "Clinical Bacteriology," "Classification of the Lactobacilli," "Decomposition of Soil Organic Matter" and "Mastitis."

THE first meeting of the International Congress of Anthropological and Ethnological Sciences will be held in London from July 30 to August 4, 1934. Sessions will be held at University College and the Wellcome Historical Medical Museum. The congress will meet hereafter every four years. Information can be obtained from the Secretaries, Royal Anthropological Institute, 52 Upper Bedford Place, London, W. C. 1.

THE department of geology and geography at Smith College has announced its plans for field work in the Black Hills of South Dakota during the summer of 1934. In addition to the usual undergraduate instruction in the general geology of the hills, the plans include a detailed study of the stratigraphy in the district southwest of Custer. The regular field courses will be given from June 21 to August 2, but it is probable that the stratigraphic research will run beyond the latter date. The 1934 program is aimed to inaugurate a series of annual investigations, in which stratigraphy and physiography are to feature.

THE Japanese correspondent of the *Journal* of the American Medical Association reports that since the epidemic of 1924, encephalitis has appeared sporadically. Since last June, however, it has again been increasing in the central parts of Japan, and suddenly it broke out in the Rin-kiu Islands in the east China Sea near Formosa. From June to the end of July, sixty-eight cases were found, with twenty-five deaths. Of 298 patients in other districts, 161 died. The total deaths were 220 out of 427 cases throughout the country. The Japan Science Promotion Association has formed a commission to study the cause of the epidemic. Professor Inada, of the medical department of the Tokyo Imperial University, has been appointed chairman. The commission is divided into eleven sections, each section having as its leader a well-known specialist. Two groups have already been sent to places where the disease is raging. As this epidemic threatens to spread all over the country, the police and physicians are cooperating to prevent a general outbreak.

SPECIAL purpose gifts, for scholarships and research, have been made to the University of Michigan. They include: From Parke, Davis and Company, $4,700 for an investigation to be conducted in the department of dietetics and surgery in the University Hospital on the dietary supply of calcium, phosphorus and vitamins A and D in relation to the healing of fractures. From the American Library Association, tender of the sum of $2,500 for fellowships in the Department of Library Science. These payments from the American Library Association represent original grants by the Carnegie Corporation. From the Upjohn Company of Kalamazoo, the sum of $750 was appropriated to continue the Upjohn fellowships in the College of Pharmacy through the year 1933–34.

THE Empire Cotton Growing Corporation will continue for five years more their grant of £1,000 to the School of Agriculture of the University of Cambridge.

PRINCETON UNIVERSITY will receive the principal sum of $900,000 after the death of survivors who are to receive the income during their lifetime, according to the will of John B. Anderson, contractor, who committed suicide last month.

SUPPLEMENTING its grant of $2,100 last spring, the Carnegie Institution of Washington has made a grant of $2,800 as emergency aid to the Institute of Forest Genetics at Placerville, California.

THE School of Dental and Oral Surgery of Columbia University announces the receipt of a second grant of money from the Commonwealth Fund of New York for the continuation of its caries research project. The initial allowance of $105,000 was made for a three-year period from February 1, 1930. The amount of the present grant is $30,000, which is to be expended over a period of two years.

A. G. C. CRUST, Meteorological Office, Wellington, New Zealand, has written to *Nature* directing attention to the advantages offered by certain sites in that country for the establishment of a large astrophysical observatory. Since statistical observations of the distribution of the various astrophysical objects over the sky are necessarily incomplete without observations of the southern skies, it is vitally important for the progress of astrophysics that a really large reflector should be established somewhere in the southern hemisphere. The only reason for the delay is, of course, the expense of erecting and maintaining an observatory with a large telescope, which would be considerable. So far, no private person or public institution has come forward with an offer to finance such an enterprise; instead, an extremely insular spirit has been exhibited in some quarters, and there seems to have been a reluctance to place the best interests of observational science above local considerations. New Zea-

land offers the advantage of a relatively high southern latitude, but it seems improbable that the astronomical observing conditions can surpass those of the Orange Free State and Transvaal, which have received extremely favorable reports from experienced observers who have worked there. Nevertheless, the claims of New Zealand should not be allowed to pass by without some examination. Mr. Crust points out that in Central Otago there is a treeless area at an elevation reaching 3,000 feet where the rainfall is less than 15 inches a year, while the number of clear nights may be so high as 276 a year.

# DISCUSSION

## PALEOSPONDYLUS[1]

THE fossil remains found in the old Silurian beds of Scotland are generally considered to be related to the myxinoids and have been named Paleospondylus. Of the several views which have been held by comparative anatomists as to the relation of Paleospondylus to other vertebrates, the majority of investigators believe that the fish-like animal which left its remains in the old red sandstone was a myxinoid. W. J. Sollas and I. B. J. Sollas published an account of the structure of the skeleton from serial sections of the fossils. These reconstructions from these sections give us the best view of the relation of the different parts of the head skeleton of this fossil yet published. The skeletal pieces lying ventrad of the ear capsule have been considered to belong to the skeleton of the gills. As a myxinoid the gills were probably located well behind the head as in the living myxinoids and the skeletal piece named the *post-branchial plate* occupies a position and has the relation to the other skeletal pieces of the *external lateral velar bars* of the living myxinoids. They lie ventral to and project back beyond the skull just as these velar bars do in the living myxinoids. The development of the notochordal skeleton of rings was continuous from the head to the tip of the tail in Paleospondylus, whereas in the living myxinoids there is a long interval between the head and the tail in which no skeletal pieces are developed. To this extent at least Paleospondylus was more advanced than the living myxinoids in the development of the skeleton for the attachment of the muscles of the body.

The admirable work of Patten and Stensiö and other students of early vertebrate animals, especially their researches among the ancient ostracoderms, brings out the need of fuller knowledge of the velum as a potent organ in the head of early vertebrates. Guided by the anatomy of living petromyzonts Stensiö located the velum in ostracoderms between what he has named the spiracular and prespiracular gills, and says that the prespiracular gill was part of the velar tissue. These deductions are based on certain bony ridges on the inner face of the bony head shield of these animals and the folds of soft tissue in the head of Ammocoetes. This reconstruction of the ostracoderm head is far from satisfactory viewed from the standpoint of the anatomy of Ammocoetes and of the ostracoderms.

Stensiö agrees that the living myxinoids and petromyzonts are primitive in their structure and for the most part not degenerate. He thinks, however, their skeleton is regressive from the ostracoderm condition of a continuous head-trunk shield of bone. He also decides the absence of pectoral fins in marsipobranchs is secondary. He assumes their ancestors had them, but that they have disappeared from the living forms of myxinoids and petromyzonts.

(1) We do not know the stages of descent of the present-day myxinoids and petromyzonts, but that they had paired appendages at any time in their history is not supported by any facts. Their whole development and life history shows that paired appendages had not been developed. There is no slightest trace in their anatomy.

(2) Among living vertebrates bone is the final stage of skeleton, not the first or most primitive stage and there is no support for the idea that the ostracoderm bony skeleton is the primitive condition from which all other forms of skeletal tissue and support organs have been derived. This is true from the standpoint of comparative morphology as well as ontogeny.

(3) The conclusion that the bony head skeleton of the ostracoderms was preceded by a cartilaginous structure similar to that of living petromyzonts is valid and well grounded in the morphology of the living marsipobranchs.

(4) The branchial basket of the marsipobranchs, as I have shown, is a development of the external velar skeleton and is not derived by the degeneration of the bony head shield of ostracoderms, from bone to cartilage and fibrous tissue with subsequent removal of this skeletal tissue by perforation, leaving only narrow strips and bars of cartilage with fibrous tissue left in the interspaces.

The marsipobranchs are primitive vertebrates when compared with other fish forms more advanced in differentiation and specialization of tissues and organs, but they are far along the road of vertebrate evolution. If one may guess the duration of geologi-

[1] Dr. Howard Ayers, author of this communication, died on October 17.

cal time they are half way from their ancestors to mammals.

HOWARD AYERS

UNIVERSITY OF CINCINNATI

## A NEMATODE PARASITE IN MYXINOIDS

IN studying Bdellostoma, the nematode parasite was found in the large subdermal blood sinus. It was usually located in the dorsal part of the sinus in the head region, and in the preserved specimens the worms were found closely coiled together and interlaced with the strong tendons connecting the skin to the trunk in the median dorsal line, also sometimes intertwined among the connective tissue strands which fasten the skin of the ventral and ventro-lateral part of the head to the muscles. The myxinoids appear not to harbor many parasites, which fact may be related to their long-continued existence. Specimens of this nematode were sent to G. Steiner, senior nematologist, of the U. S. Department of Agriculture in 1928. Steiner named it *Tetanonema strongylurus,* new genus, new species. At that time nothing was known of the method of propagation. I have recently found, however, that the microscopic embryos of the parasite leave the body of the parent Bdellostoma in the eggs and are to be found in the growing embryo before hatching as well as after hatching, coiled in the tissues of the gills. Whether they infest other parts of the embryo Bdellostoma is yet unknown. So far as I know this is the sole animal parasite occurring in the myxinoids, and no plant parasite is known to attach itself to or live within the body of these animals. How the filaria of this nematode enter the Bdellostoma egg and at what stage of the growth of the egg is not known. They enter before the micropyle is fully formed. None of the adult nematodes have been found in the gills of the adult Bdellostoma, but colonies of the worms numbering up to one hundred or more occur in the subdermal blood sinus.

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UNIVERSITY OF CINCINNATI

## THE THICKNESS OF THE GLACIAL DEPOSITS IN OHIO

AN examination of nearly 2,800 well records, obtained from the files of four oil companies which operate in Ohio, has revealed some interesting facts concerning the topography of Ohio in preglacial and interglacial time. It was possible to obtain figures for the thickness of the glacial drift over an area of approximately 4,637 square miles in north central Ohio, in Cuyahoga, Summit, Lorain, Medina, Ashland, Wayne, Richland, Holmes, Tuscarawas, Portage and Coshocton counties. As expected, it was found that the thickness of the glacial drift is much greater in the preglacial and interglacial valleys, the majority of which coincide, in trend, with the present valleys. On the buried uplands between the valleys, the thickness of the drift varies, and appears to be thinnest along Lake Erie, where in places it is not much above 20 feet in thickness. Fourteen quadrangles show average thicknesses over the buried uplands varying from 37 to 67 feet. For the entire area, the thickness over the buried uplands averages 51 feet.

The depth of the glacial drift in the buried valleys averages from 155 feet in the Wellington quadrangle to 380 feet in the Cleveland quadrangle. The average thickness of the drift for all the buried valleys in the entire area is 205 feet. The maximum thicknesses in feet for the fourteen quadrangles range from 192 feet for the least, to 763 feet for the greatest. Thicknesses of 300 feet and over are common throughout the area. The thickness of the drift, over all, taking the average for buried valleys and uplands in the entire area, is 95.7 feet. This figure was derived by taking the average of all the well records, a total of 2,782. The Oberlin and Berea quadrangles, located farthest north, along Lake Erie, have the least thickness, 54 and 43 feet, respectively, whereas the area farther south represented by the Medina, Akron, Ashland, West Salem, Wooster, Massillon, Canton, Perrysville, Loudonville and Millersburg quadrangles have thicknesses of 85, 111, 90, 81, 80, 154, 97, 88, 90 and 94 feet, respectively. The greater thicknesses are explained by the facts that, where they occur, there are either deep buried valleys or morainic belts.

The greatest thickness in the entire region and possibly in the State of Ohio, 763 feet, is located south of Cleveland, in Newburg township, about two miles directly east of the village of Independence. Here a north-south buried valley marks the course of the preglacial or interglacial Cuyahoga River. Other thicknesses in this valley are 605, 560, 519 and 500 feet and many more greater than 400 feet. The elevation of the bed-rock which marks the buried surface, at the point where the thickness of the drift is 763 feet, is 13 feet below sea-level and 586 feet below the present level of Lake Erie. The bottom of this valley stands 800 to 900 feet below the buried upland, as indicated by well records in Newburg and Independence townships. It appears to have been a narrow gorge in the youthful or early mature stage in the cycle of erosion and may have stood much higher than at present. The buried valleys throughout the area are, with few exceptions, narrow at the bottom, but their upper portions are broad, with rather gently sloping uplands. It is probable that the valley of the old Cuyahoga, and other buried valleys in the region, are not the result of stream erosion alone, but have been deepened and otherwise changed by glacial erosion.

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## BIOLOGICAL ISOMERISM OF WATER MADE OF PROTIUM AND DEUTERIUM

THE discovery of the hydrogen isotopes of mass one (protium) and mass two (deuterium) opened an interesting and fruitful field for investigations not only in physics and chemistry but also in biology. The recent report of Professor Gilbert N. Lewis in the August issue of the *Journal of the American Chemical Society* indicates that water containing 100 per cent. of $H_2{}^2O$ does not cause the seeds of tobacco to sprout.

The process of germination in seeds or spores is usually associated with the penetration of water through the seed coat and the protoplasm membrane. The absence of germination may be explained, therefore, on the assumption that the $H_2{}^2O$ molecules are stopped by an organic tissue, which at the same time is permeable to $H_2{}^1O$ molecules. If such selective transmission is taking place also at the surface of the primary and secondary roots, then the water content of a plant must be composed of water containing only protium, whereas the water on which the plant was fed will be relatively more abundant in deuterium. It would be of great interest to analyze the water distilled from different plants in various stages of their growth.

Another possibility is that the heavy water is able to penetrate the seed coat but does not participate in the process of cell division, *i.e.*, germination and growth. If heavy water has a lethal action, then it is to be expected that feeding a seed on water containing only protium will result in a more rapid development.

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## THE SPIRAL HABIT

REFERRING to the wonderfully interesting article entitled "More about the Spiral Habit," by Professor William Seifriz, appearing in the October 20 issue of SCIENCE, in which the author traced the "spiral habit" all the way up from protoplasm, may I add the further interesting suggestion that this same "spiral habit" seems to be deeply ingrained in all nature; as it seems to be clearly in action, in the wave-shape of light in the "ether" body of conductance—so much for the wave motion of the "ether molecules"; and, so far as I know, the wave motion is still best explained by the old theories of Fresnel and his classic school of the experimental action of light.

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# SPECIAL CORRESPONDENCE

## ACADEMIC FREEDOM IN GERMANY

A CORRESPONDENT writes from abroad to the editor of SCIENCE:

As an old "Frontkämpfer" for academic freedom, I am sure you will be interested in the enclosed abstract of the new constitution for the Bavarian universities if you have not seen it. I don't suppose the wrecking of the freest and most self-respecting of all communities of scholars will create much excitement in America, where we have always had what might be termed in the new parlance "a managed university." But those of us who have hoped for a freer and more liberal form of administration as our educational system comes of age will be distinctly depressed by this regressive step on the part of the Nazi Government. Apparently, all that has been gained since academic freedom was first evolved and practised in Göttingen and Halle nearly two centuries ago has been lost.

Most Americans will probably be surprised to learn that academic freedom was guaranteed by the Weimar Constitution in a section that read, "Science and its teaching shall be free." No German politician can claim that German universities have not met every obligation, real or implied, owed either to the state or society, but the present rulers of Germany are apparently taking no chances on sedition brewing where thought once was and should be free.

It is a dubious compliment the Bavarian Minister has paid us in copying some of the worst features of American university administration. Practises that may, perhaps, be excused or, at least, understood in a young country with a rapidly growing population and expanding educational system are not the measures to imitate and incorporate into what were, probably, the best universities that the world has thus far produced. By its action, the Hitler Government has dealt them a fatal blow. Under a system such as the new constitution imposes, disintegration of the morale of the universities is inevitable. Scholars, trained in freedom, who have worked in the liberal atmosphere previously existing in the German universities, will hardly remain productive under a system suggestive of military oversight and control. Any kind of intellectual thralldom—particularly political—is alien to all the principles conducive to the development of great scholars. One wonders whether another Parthenon has not been destroyed.

The idea of students sitting in the university senate approaches the ridiculous. Students rarely know what is good for them. Moreover, the faculty always

knows the student point of view, owing to the Hanns Sachs-David relationship, which is the essence of the bond between teacher and pupil. In the present Nazi revolution, there have been instances of men of international distinction and renown who have had the doors of their lecture rooms barred by Nazi students. In one instance, at least, the ministry supported the students and not the professor. And this, in the universities of a land where for a century the rights of free teaching and free study have been an example and a lesson to the world. No professor was compelled to teach any one he didn't choose, and no student was forced to listen to any professor he didn't elect. With such an example of ministerial disloyalty, decay of the morale of the universities becomes inevitable.

You are at liberty to use this material in any way you choose, but I must ask you to withhold my name, as my connection with some German colleagues who have talked freely to me of the present situation could be easily traced. And if it were, it might cost them their positions or even more.

The new constitution of the Bavarian universities as described in translation from the Münchener *Neueste Nachrichten,* August 31, is as follows:

Bavaria is the first of the larger Provinces to receive, through Minister of Culture Schlemm, a new university constitution. Primarily, it modifies the status of the rector and the senate, but a new constitution is in preparation for the faculties. However, in many respects, the present decree also affects the faculties.

A double problem was presented for solution. It was essential, at the same time, to incorporate the Bavarian universities into the National Socialistic State as well as to keep this incorporation in harmony with the long existing principle of self-government of the universities. These prerequisites determine the constitution.

The university—hitherto a self-elected corporation administered by parliamentary methods—is now placed under the leadership of a man, the rector, responsible to the National Socialistic State. The rector is appointed by the minister. He is no longer, as formerly, elected by the professors. The senate has, however, the right to make recommendations for this appointment.

The rector appoints his alternate. He may, for the period of his appointment, entrust members of the university with the preparation and settlement of regular university business.

The academic senate which hitherto constitutionally conducted the affairs of the university resigns its authority to the rector and becomes his advisory body. The senators, as well as their alternates, are no longer elected but are appointed by the rector. Among them must be at least one scientific assistant as well as students when student affairs are to be considered.

In the new constitution, the self-government of the university in scientific fields is maintained. Also in the future, as hitherto, will the scientific concerns of the university be administered by the faculties in faculty meetings under the supervision of the state. But the following new regulations concerning the faculties are contained in the constitution. Deans were formerly elected; in the future they will be appointed by the rector. They are no longer executives of the faculties, but have, in their character of appointees of the rector, the management of the faculties. The deans appoint their alternates and the committees of the faculties. All communications of the faculties to the minister are to be transmitted in writing through the rector. The deans are to inform the rector of all important conclusions of the faculties and of all weighty measures that are brought before them. Against votes of the faculties, the deans may protest. Should a faculty reject the protest of a dean, the rector decides.

These are the principal features of the new university constitution promulgated by Minister Schlemm. In place of the hitherto parliamentary-democratic methods of self-government of the Bavarian universities, there is now substituted the principle of political leadership or management.

A corresponding modification of the constitution for the technical high schools in Munich will also follow.

# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## A SORTING STAGE FOR FORAMINIFERA

IN picking out Foraminifera from an unsorted sample the chief concern is to get specimens of all the species present. This, among other things, involves seeing the specimens on every square centimeter of the sorting dish each time it is filled. To be certain that no section of the dish has been missed, some system of control must be employed; and, after numerous experiments, it became apparent that a modified mechanical stage is the best answer to the problem.

Some time ago I designed and built such a stage for use in our laboratory here at New York University. Since then it has been in constant use and has proved to be very satisfactory. We have found it especially helpful where the quantity of material to be examined has been large.

As may be seen from the figure, this sorting stage consists essentially of a stationary stage base and a traveling rotating stage for carrying the sorting tray. The stage base (A) is fastened rigidly to the microscope by flanges (B) which fit into the grooves designed for the usual glass stage. In the center of this stage base is an elongated rectangular opening (C) running from front to back and acting as a track for a rectangular guide attached to the bottom of the

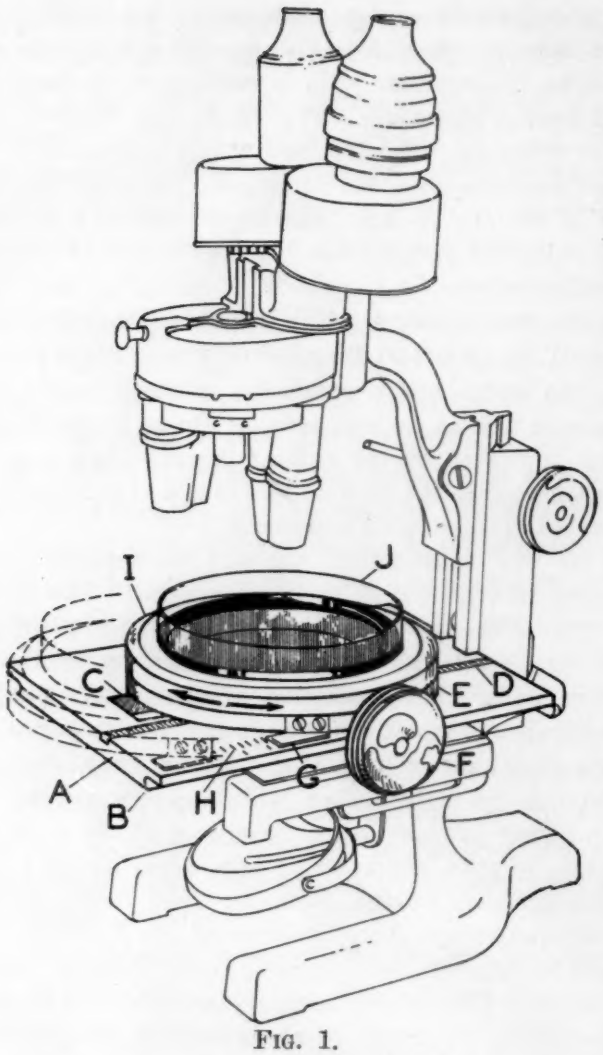


FIG. 1.

traveling element. Parallel to this opening is a slot carrying a rack (D) which meshes with a pinion gear in the bottom of the traveling stage.

This traveling stage (E) is moved back and forth by the adjusting screw (F), the distance being indicated by the pointer (G) and the scale (H). Above the traveling element is the rotating stage (I) which revolves about an axis fixed in the center of the lower disk (E). It bears on its upper surface a circular depression turned to receive a petri dish (J).

To operate the stage one moves the traveling rotating element to a position such that the center of the sorting dish is visible. After examining all specimens in the field of view the stage is moved forward one division on the scale calibrated for the particular magnification used, each division being a little smaller than the width of the field. In the new position the stage is rotated, as picking out progresses, until finally it has been turned through 360°. Then it is again moved forward and again rotated. This process is repeated until the entire sorting dish has been covered.

The front and rear of the stage base are interchangeable so that the adjusting screw may be placed on either the right or the left side of the microscope. Also the stage operates freely when the bottom portion of the microscope stand has been removed. This is a very desirable feature, since most workers prefer the low stand when sorting samples.

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## COLORIMETRIC METHOD FOR DETERMINATION OF $CO_2$ IN GAS MIXTURES[1]

IN a previous publication,[2] a method was described for determination of $CO_2$ in gas mixtures which depends on determining the pH of a standard $NaHCO_3$ solution in equilibrium with the gas mixture. The theory of the method was treated in that paper and will not be discussed in the modification to be described. In the original method, the pH was determined by means of a glass electrode in order to achieve a reasonably high degree of accuracy. In many cases, however, such accuracy is not so desirable as is a rapid, simple, convenient method. Examples might include determination of $CO_2$ in the air of a room, greenhouse, hot-bed or over field crops in which relative values for comparative purposes are desired rather than exact quantitative data. For such cases, a modification of the original method by determining the pH colorimetrically is possible.

The pH determinations were made with Hellige color disks, since these offer several advantages over other colorimetric devices, *e.g.*, permanence of standards, compactness and accuracy of reading. With a little experience, an accuracy of 0.05 pH units is possible with the simple system measured in this method.

It was found that the calibration curve prepared for the original method could not be used for colorimetric determinations. The pH values found for a given $pCO_2$ were 0.1 to 0.3 pH units too low, varying with the indicator. This "systematic error" was constant for a given indicator, hence, if an empirical curve for the indicator used is constructed, the error does not interfere with the application of the method. The data of Higgins and Marriot,[3] who described a colorimetric method similar to this one, likewise show this systematic error, which is probably due to the buffering effects of the indicator and to lack of complete equilibration between solution and atmosphere. It was noticed also that not all indicators were equally satisfactory for the method. Aside from the difference in systematic error, certain indicators did not give accurate readings, except in the middle of the range. The most consistent results were obtained with Brom-thymol-blue for the acid range and Cresol

[1] Frasch Foundation Research in Agricultural Chemistry, Paper No. 69.

[2] P. W. Wilson, F. S. Orcutt and W. H. Peterson, "A Potentiometric Method for the Determination of $CO_2$ in Gas Mixtures," *Ind. Eng. Chem.*, Anal. Ed., 4: 357–361, 1932.

[3] H. L. Higgins and W. M. Marriot, "A Colorimetric Method for Determination of $CO_2$ Percentage in Air," *Jour. Am. Chem. Soc.*, 39: 68–71, 1917.

Red or Alpha Naphtholphthalein for the alkaline. Accordingly, these indicators were used in preparing the calibration curve.

The calibration curve was constructed by mixing $CO_2$ with air to give an atmosphere of known $pCO_2$; the volume of each component was measured in a standardized flow meter. The $CO_2$ content was checked by absorption of the $CO_2$ in a measured volume of the atmosphere in 0.1 N NaOH contained in a Truog tower and titrating the excess alkali to the Thymol Blue end-point. At the same time, the atmosphere was bubbled through about 4 cc of standard $NaHCO_3$ solution plus indicator in a 13 mm Board of Health test-tube fitted with an inlet tube drawn to one mm capillary tip. The equilibration of the $NaHCO_3$ solution required about 5 minutes, after which the test-tube was transferred to the comparator and the pH estimated. Duplicate determinations, which never varied more than 0.05 pH units, were made with each indicator used.

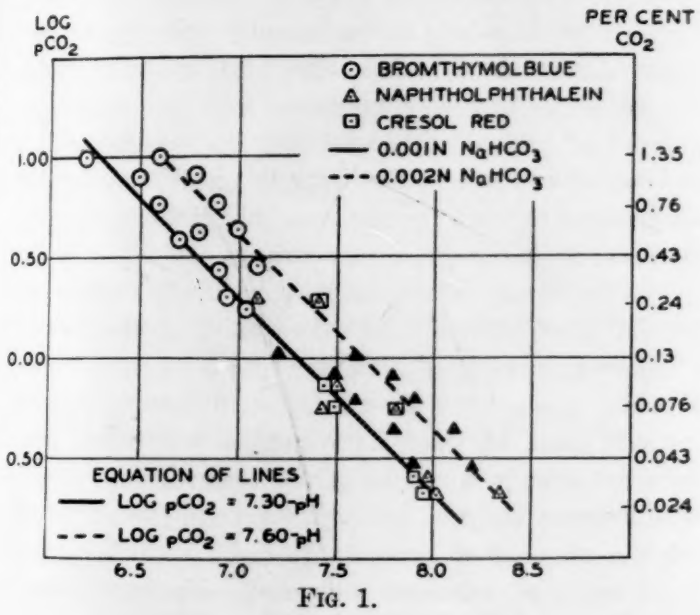


FIG. 1.

The calibration curve is given in Fig. 1; two concentrations of $NaHCO_3$ were used to give a check on the systematic error of the indicators. The solid symbols represent values obtained with 0.0107 N and 0.0214 N $NaHCO_3$; the $pCO_2$ corresponding to each of these points was divided by 10 before plotting. The curve, as given, is for use with 0.001 N or 0.002 N $NaHCO_3$, but by use of 0.0107 N or 0.0214 N $NaHCO_3$ solution, pressures of $CO_2$ ten times those indicated on the ordinates can be estimated.[2] The values for the percentage of $CO_2$ were calculated on the assumption of an average barometric pressure of 740 mm. It is to be noticed that the points lie along a line with the proper slope of unity and are displaced from each other by the theoretical value, *viz.*, 0.3 pH units.

Use of the method in routine analysis of air in a greenhouse is illustrated by the following example: To 20 cc of standard $NaHCO_3$ solution is added 1 cc of indicator solution (Brom-thymol-blue for a $pCO_2$ greater than 0.15 per cent.) and approximately 4 to 5 cc of the mixture placed in a 13 mm test-tube provided with a drawn-out inlet tube. The outlet tube is attached to a bottle containing water and fitted with a syphon. About 500 cc of air is drawn through the $NaHCO_3$ solution by displacement of water in the syphon, the pH determined by comparison with the proper color disk, then the $pCO_2$ read from Fig. 1. For routine analysis, a table in 0.05 pH units can easily be constructed for average barometric pressures by means of the equations of the lines given in Fig. 1. If the pH is read to 0.05 units, the error in the determination will be 10 per cent. or less.

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# SPECIAL ARTICLES

## A VIRUS ENCOUNTERED IN THE STUDY OF MATERIAL FROM CASES OF ENCEPHALITIS IN THE ST. LOUIS AND KANSAS CITY EPIDEMICS OF 1933

A VIRUS has been disclosed by the intracerebral inoculation of special mice with brain tissue from fatal cases of encephalitis occurring in St. Louis and Kansas City during August and September, 1933.[1] The mice employed, bred in our laboratory as part of a study of inherited factors in susceptibility and resistance to infectious diseases,[4] had previously proved susceptible to an infectious encephalitis of sheep.[5] It seemed possible, therefore, that experiments with these animals might throw light on the nature of the human encephalitis.

Brain tissue preserved in 50 per cent. glycerol from each of eight St. Louis cases[6] was ground in a sterile mortar, diluted in 0.85 per cent. salt solution to approximately a 10 per cent. solution by weight, cultured aerobically and anaerobically to detect the pres-

[1] Muckenfuss, Armstrong and McCordock have already reported (foot-notes 2 and 3) that a condition similar to the St. Louis encephalitis has been reproduced in monkeys and has been maintained through five passages.

[2] J. P. Leake, *J. A. M. A.*, 101: 928, 1933.

[3] R. S. Muckenfuss, C. Armstrong and H. A. McCordock, *Public Health Rep.*, 48: 1341, 1933.

[4] L. T. Webster, *J. Exp. Med.*, 57: 793, 1933.

[5] L. T. Webster and G. L. Fite, *Proc. Soc. Exp. Biol. and Med.*, 30: 656, 1933.

[6] Dr. Muckenfuss collected and sent material to us in New York. This assistance is gratefully acknowledged.

ence of bacteria, and then injected intracerebrally in 0.03 cc quantities into two white-face and two Swiss mice.

The mice remained well and active for four days. Two mice from Case 3 were dead on the sixth day, and one in convulsions was killed. One mouse from Case 4 with convulsions on the sixth day and one prostrate on the ninth day were killed. One mouse from Case 5, prostrate on the eighth day, was killed; and one from Case 8 was dead on the ninth day. All these, with one exception, were white-face mice. The others, including all mice from Cases 1, 2, 6 and 7, remained well.

The brains from the dead mice were removed aseptically, cultured aerobically and anaerobically and found sterile, treated as before, and injected intracerebrally into two white-face and two Swiss mice. In each instance, the injected mice remained well three days and were all dead by the fifth day.

The four strains of virus have given uniform results in white-face, Swiss and other susceptible strains of mice[4] for as many as fifteen passages. After a three- or four-day healthy period, all animals show ruffled fur and hyperesthesia. Tremors, convulsions and prostration develop rapidly and progress to a fatal conclusion in from five to nine days.

The lesions in the central nervous system consist for the most part of accumulations of mononuclear cells in the pia, about the blood vessels of brain and spinal cord and in scattered foci. The pyramidal cells of the cornu Ammonis and lobus piriformis are injured. Some of the cells are ameboid in outline; others are necrotic, thus disturbing the regular architecture of these regions. Certain nerve cells of the basal ganglia and anterior horns of the spinal cord appear damaged and collared by mononuclear cells.

When the mouse brain virus is instilled intranasally in 0.03 cc quantities, fatal signs develop in practically 100 per cent. of white-face and Swiss mice. After a five- to six-day incubation period, the tremors and convulsions ensue, terminating in death by the tenth day. The lesions of the central nervous system are similar to but less intense than those in intracerebrally injected mice.

Intracerebral injections of the mouse brain virus into Rockefeller Institute stock mice and specially bred virus-resistant mice produce disease in a relatively small percentage of animals.

*Macacus rhesus* monkeys, given 1 cc of mouse brain virus intracerebrally, have invariably shown significant elevations of temperature in from seven to nine days, lasting three to five days and followed by either hyperirritability or apathy. In some cases, coarse tremors are present. Hyperirritable animals later become weak and drowsy; apathetic animals continue so for at least fourteen days. This condition has been induced regularly for four monkey passages. Blood and spinal fluid drawn from four monkeys during the febrile period and injected intracerebrally into mice has had no effect; brain tissue from monkeys etherized seven to twenty-eight days after injection, when so treated, has invariably brought about the characteristic fatal disease in mice.[7] The central nervous system lesions in the injected monkeys consist of collections of mononuclear cells in the pia and perivascular collaring of mononuclear cells and foci of mononuclear cells and injured nerve cells scattered throughout the brain and cord, together with injury to some of the nerve cells of the basal ganglia and anterior horns.

The different strains of virus produce identical effects in mice. They are active in dilutions as high as $10^{-5}$ injected intracerebrally. Berkefeld N candle filtrates in dilutions as high as 1/2000 likewise prove fatal.

Brain tissue preserved in glycerol from two fatal cases of encephalitis in Kansas City in September, 1933,[8] was injected intracerebrally into white-face mice. One mouse from one case in convulsions on the ninth day was sacrificed and its brain prepared and passed intracerebrally to two white-face and two Swiss mice. Six days later all were having convulsions or were prostrate. This virus has proved identical with the St. Louis strains.

The following statement may be made on the nature of these viruses. The possibility of their being a native mouse virus is unlikely because mice in the breeding room have shown no such disease, because sections from at least sixty normal white-face mice have not disclosed lesions of the central nervous system, because brain to brain passages in these animals for the purpose of bringing to light a similar agent from cases of common cold, acute rheumatic fever and poliomyelitis have been consistently negative, and finally, because repeated attempts at isolating the present strains of virus from the original human tissues gave positive results in the cases which previously were positive, and negative results in the cases which previously were negative, and another later attempt, when the active human brain tissue was at least six weeks in glycerol, gave negative results in all cases. The agent does not appear to be related to louping-ill virus of sheep because sera protecting mice against at least 100 lethal doses of this virus have no effect upon the present one. Monkeys injected with it do not show the cerebellar signs of incoordination and lesions so characteristic of louping-ill.

[7] Muckenfuss, Armstrong and McCordock report (footnote 3) that the disease in monkeys with which they are working may be transferred and established in mice.

[8] Dr. Paul Stookey sent us the brain tissue and convalescent sera from Kansas City cases. We gratefully acknowledge this assistance.

The virus does not appear to be related to vesicular stomatitis or to equine encephalomyelitis, since it is non-pathogenic for guinea pigs when injected intracerebrally and because it is not neutralized when injected in mice with immune sera for equine encephalomyelitis and vesicular stomatitis.[9] The virus appears unrelated to herpes virus since rabbits show no effects following intracerebral, corneal and intradermal injections.

Sera from convalescent St. Louis[10] and Kansas City cases, in contradistinction to sera from non-contact healthy adults, appear to possess specific protective substances. Virus suspensions were mixed with undiluted human sera to give final virus dilutions of $10^{-3}$, $10^{-4}$, $10^{-5}$ and $10^{-6}$. The mixtures were incubated at 37° for two hours and inoculated intracerebrally into four Swiss mice. Six sera, including one positive and one negative control, were tested at one time. The table summarizes a protocol of one of these titrations.

Thus far, sera from eight normal adults in New York tested twice have shown no protective qualities. Sera from eight St. Louis encephalitis convalescent cases, tested twice, however, all show definite protective properties.

PROTECTION TEST

| Sera | Virus-Serum Dilution $10^{-3}$ | $10^{-4}$ | $10^{-5}$ | $10^{-6}$ |
|---|---|---|---|---|
| J., Normal New York | 5*, 5, 6, 8 | 7, 7, 8 | 8 | |
| K., Normal New York | 4, 5, 5, 8 | 5, 5, 5, 6 | 7, 7, 7 | |
| R., Normal New York | 5, 5, 5, 7 | 5, 5, 5, 7 | | |
| No. 10 St. Louis Convalescent | 6 | | | |
| No. 9, St. Louis Convalescent | 7, 9, 10 | | | |
| No. 33, St. Louis Convalescent | 8, 10 | 8 | | |

* Duration of life of mouse in days. Blanks indicate mice remained healthy.

The facts presented would indicate that the active agent is a specific filtrable virus, etiologically related to the encephalitis prevailing in St. Louis and Kansas City and that one possible mode of its transmission is by way of the upper respiratory tract. Final decision on these questions must be reserved, however, until the work in progress has been completed.

LESLIE T. WEBSTER
GEORGE L. FITE

THE LABORATORIES OF THE
ROCKEFELLER INSTITUTE
NEW YORK CITY

[9] The writers are indebted to Dr. H. R. Cox for the immune sera used and assistance in these tests.

[10] These sera were obtained from cases at the St. Louis City Isolation Hospital by Dr. S. Weisman through the courtesy of Dr. J. Eschenbrenner.

## THE EXISTENCE OF NON-CHROMOSOMAL INFLUENCE IN THE INCIDENCE OF MAMMARY TUMORS IN MICE[1]

THE object of this communication is to record the existence of extra-chromosomal influence, extending for more than one generation and affecting the natural incidence of spontaneous mammary tumors in mice.

The data are based on four independently conducted experiments which have continued over a period slightly in excess of three years. Seven distinct inbred strains of mice (six derived from *Mus musculus,* and one the direct descendants of wild *Mus bactrianus*) have been used. The results in all four experiments are consistent with, and confirmatory of, one another. Since in our experience females only have formed spontaneous mammary tumors, that sex alone is included in the tabulation of tumor incidence. More detailed papers on the different experiments will later be published. The present note seeks merely to record certain facts of general interest and application.

The opportunity to detect extra-chromosomal influence is offered by a comparison of the incidence of spontaneous mammary tumors among the female mice derived from reciprocal crosses between distinct "high tumor" and "low" or "non-tumor" strains. Although no mammary tumors have been recorded in certain strains designated as "low tumor," it seems better to use that term as an admission that the possibility of the future appearance of such neoplasms is recognized.

Since in such reciprocal crosses the chromosomal constitution of $F_1$ females is similar (both as regards sex chromosomes and autosomes) it follows that any significant difference in tumor incidence which may exist between the two types of cross is extra-chromosomal. If this difference continues beyond the $F_1$ generation, direct transmission through the extra-chromosomal portion of the germ-cell is clearly indicated.

In the following table the incidence of spontaneous mammary tumors in $F_1$ females is recorded in four experiments (A, B, C, D). The reciprocal crosses are shown in each case. In every instance the incidence of spontaneous mammary tumors in $F_1$ is strikingly and significantly higher when the cross is made between a female from a high tumor strain and a male from a low tumor strain, than it is when the cross is made in the reciprocal manner (low tumor line ♀ × high tumor line ♂). In experiments A and

[1] Acknowledgment of a grant from the American Academy of Arts and Sciences in partial support of this work is hereby made.

B the odds against the possibility that the difference between reciprocal crosses is due to chance are nearly, and in excess of a million to one, respectively. In crosses C and D also the difference is obvious.

TABLE 1[2]

| Experiment | Type of cross | | | No. $F_1$ ♀s | Percentage mammary tumors |
|---|---|---|---|---|---|
| A | D ♀ (high tumor line) | × | C 57 blk ♂ (low tumor line) | 61 | 36.06 |
| | C 57 blk ♀ (low tumor line) | × | D ♂ (high tumor line) | 307 | 5.53 |
| B | D ♀ (high tumor line) | × | *M. bactrianus* ♂ (low tumor line) | 69 | 68.11 |
| | *M. bactrianus* ♀ (low tumor line) | × | D ♂ (high tumor line) | 27 | 7.41 |
| C | A ♀ (high tumor line) | × | X ♂ (low tumor line) | 22 | 86.3 |
| | X ♀ (low tumor line) | × | A ♂ (high tumor line) | 6 | 0.0 |
| D | Z ♀ (high tumor line) | × | I ♂ (low tumor line) | 30 | 90.0 |
| | I ♀ (low tumor line) | × | Z ♂ (high tumor line) | 10 | 0.0 |

The greater influence of the female as compared with the male parent in determining the incidence of spontaneous mammary tumors in mice is thus clearly established. This fact makes necessary a reconsideration of any genetic conclusions drawn from data in which only one of the two types of crosses has been considered, or in which the two types have been treated as one.

The persistence of the difference in the $F_2$ generation has been demonstrated by an extensive study of over 1,100 $F_2$ females derived from Experiment A. These show the following incidence of mammary tumors.

| Derivation of $F_2$ ♀s | Total $F_2$ ♀s | Percentage with mammary tumors |
|---|---|---|
| $F_1$ (D ♀ (high tumor) × C 57 ♂ (low tumor)) *inter se* | 650 | 31.07 |
| $F_1$ (C 57 ♀ (low tumor) × D ♂ (high tumor)) *inter se* | 489 | 7.39 |

The $F_2$ females derived from the high tumor grandmothers and high tumor $F_1$ mothers give again a significantly greater incidence of mammary tumors. The chance of the two $F_2$ groups being similar is much less than one in a million.

This establishes the transmission of extra-chromosomal influence. Because of that fact the simple Mendelian genetic nature of the biological agents influencing the etiology of spontaneous mammary tumors is definitely disproved.

This should not be taken as denial of the existence of chromosomal influence. There is clear evidence that such influence also is present and effective. Further studies are already under way to attempt to determine more accurately the nature and extent of both chromosomal and extra-chromosomal influences.

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[2] No detailed comparison between experiments A, B, C and D should or will be attempted until complete results are published. The important point at present is the consistent nature of the difference between the reciprocal crosses.

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